

INTRODUCTION TO SIMULATION



Simulation

- A Simulation is the imitation of the operation of a real-world process or system over time
- A system is defined as an aggregation or assemblage of objects joined in some regular interaction or interdependence toward the accomplishment of some purpose.
- A model is defined as a representation of a system for the purpose of studying the system.

Advantages of Simulation

- Simulation can also be used to study systems in the design stage, “what-if” questions can be answered.
- New policies, operating procedures, decision rules, information flow, etc can be explored without disrupting the ongoing operations of the real system.
- Insight can be obtained about the interaction of variables.
- Insight can be obtained about the importance of variables to the performance of the system.

Disadvantages of simulation

- ❑ Model building requires special training.
- ❑ Simulation results may be difficult to interpret.
- ❑ Simulation modeling and analysis can be time consuming and expensive.
- ❑ Simulation is used in some cases when an analytical solution is possible or even preferable.

System

- A system is defined as an aggregation or assemblage of objects joined in some regular interaction or interdependence toward the accomplishment of some purpose.

Components of a System

□ Entity

- ▣ An entity is an object of interest in a system.
- ▣ Ex: In the factory system, departments, orders, parts and products are The entities.

□ Attribute

- ▣ An attribute denotes the property of an entity.
- ▣ Ex: Quantities for each order, type of part, or number of machines in a Department are attributes of factory system.

□ Activity

- ▣ Any process causing changes in a system is called as an activity.
- ▣ Ex: Manufacturing process of the department.

Components of a System

□ State of the System

- ▣ The state of a system is defined as the collection of variables necessary to describe a system at any time, relative to the objective of study.
- ▣ In other words, state of the system mean a description of all the entities, attributes and activities as they exist at one point in time.

□ Event

- ▣ An event is define as an instantaneous occurrence that may change the state of the system

System Environment

- Endogenous System

- ▣ The term endogenous is used to describe activities and events occurring within a system.
- ▣ Ex: Drawing cash in a bank.

- Exogenous System

- ▣ The term exogenous is used to describe activities and events in the environment that affect the system.
- ▣ Ex: Arrival of customers.

System Environment

- Closed System

- A system for which there is no exogenous activity and event is said to be a closed.
- Ex: Water in an insulated flask.

- Open system

- A system for which there is exogenous activity and event is said to be a open.
- Ex: Bank system.

System Environment

□ Continuous Systems

- ▣ Systems in which the changes are predominantly smooth are called continuous system.
- ▣ Ex: Head of a water behind a dam.

□ Discrete Systems

- ▣ Systems in which the changes are predominantly discontinuous are called discrete systems.
- ▣ Ex: Bank – the number of customers changes only when a customer arrives or when the service provided a customer is completed.

The Model

- A model is defined as a representation of a system for the purpose of studying the system.
- It is necessary to consider only **those aspects of the system that affect the problem** under
- investigation. These aspects are represented in a model, and by definition it is a simplification of
- the system.

The Model

- Static Model
 - ▣ Represents a system at a particular point of time and also known as Monte-Carlo simulation.
- Dynamic Model
 - ▣ Represents systems as they change over time.
Ex: Simulation of a bank

□ Deterministic Model

- ▣ Contains no random variables. They have a known set of inputs which will result in a unique set of outputs. Ex: Arrival of patients to the Dentist at the scheduled appointment time.

□ Stochastic Model

- ▣ Has one or more random variable as inputs. Random inputs leads to random outputs. Ex: Simulation of a bank involves random interarrival and service times.

